Office of Space Science

STRUCTURE AND EVOLUTION OF THE UNIVERSE SUBCOMMITTEE

OF THE

SPACE SCIENCE ADVISORY COMMITTEE

February 24-25, 2004

Inn and Conference Center, University of Maryland
College Park, MD

MEETING REPORT

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Paul Hertz	Edward W. Kolb
Executive Secretary	Chair

STRUCTURE AND EVOLUTION OF THE UNIVERSE SUBCOMMITTEE (SEUS)

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MEETING MINUTES

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Joan M. Zimmermann, Consultant

RS Information Systems, Inc.

STRUCTURE AND EVOLUTION OF THE UNIVERSE SUBCOMMITTEE (SEUS)
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Meeting Minutes

February 24, 2004

Welcome

Dr. Rocky Kolb, Chair of the Structure and Evolution of the Universe Subcommittee (SEUS), welcomed members and opened the meeting. Dr. Paul Hertz, Executive Secretary and Theme Scientist, reminded members of the rules of engagement for a public meeting, including conflict of interest concerns. It was noted that the Space Science Advisory Committee (SScAC) will be meeting in March, and members were asked to bring up any significant issues in order to forward them up the advisory chain.

SEU Theme Update

Dr. Paul Hertz, Theme Scientist, gave a thematic overview of the budget and other Structure and Evolution of the Universe (SEU) matters. The newly announced Presidential vision has had a huge impact on SEU. The FY05 budget supports the President's vision for space exploration; the space science budget will increase by 4% in the coming year and 40% over four years. There are four space science themes considered part of the exploration budget - Astronomical Search for Origins, Solar System Exploration, Mars Exploration, and Lunar Exploration. As a result of these changes, there has been a delay in LISA, Constellation-X, and elimination of any funding for Einstein Probes for at least 5 years, but additional funding has been made available for Gravity Probe B (GP-B), Gamma-ray Large Area Space Telescope (GLAST) and Swift. In the Astronomical Search for Origins theme, the Hubble Space Telescope SM-4 mission has been cancelled, and the James Webb Space Telescope (JWST) budget has been optimized to support schedule recovery. The SEU budget was reviewed. Research and Analysis (R&A), Chandra, and GLAST have not been impacted adversely during FY04-FY05, remaining roughly the same, with a small inflationary increase (1%) for R&A. Five-year budget projections indicate minor decreases in the near-term, with a late upturn to support the Laser Interferometer Space Antenna (LISA) launch.

Mission status was reviewed. GP-B is in great shape. The electronics boxes have been repaired and installed. Operations teams have passed their readiness reviews, and the mission is ready for an April 17 launch. There are problems with the Swift image processor (ground bounce); the processors are being redesigned- if the problem can be fixed without a schedule impact, a September 2004 launch is anticipated. GLAST has had a number of small technical problems, including failure of some photomultiplier tubes. The Extreme Universe Space Observatory (EUSO) is code red because the solutions are out of SEU hands. ESA has extended its phase A studies; they will know if they are going ahead by November of this year. US, Switzerland, and Portugal are the only countries that have committed. The earliest possible launch date is the end of 2010. There is a challenge in addressing appropriate manifest opportunities. Soyuz will be relied upon for crew changes until a new manned space vehicle is built. Japan and Europe have vehicles for International Space Station (ISS) upmass requirements. Herschel and Planck deliveries will be late this fiscal year or next fiscal year.

The reduction in the FY05-09 budget requires serious replanning. For LISA, NASA must slow down planned work to match the budget and to identify resource mismatches with ESA. Con-X has had a significant budget decrease. An opportunity has arisen to internationalize Con-X as a means of realizing the mission more quickly and discussions will begin with potential international partners to address this issue. The Einstein Probe mission concept studies are moving forward, as the science is still compelling and should continue to be advocated. The Beyond Einstein (BE) Education/Public Outreach (E/PO) will continue with a concentration on LISA in the near term. This year's budget came straight out of the White House and accounts for the perceived "logic" behind budget allocations. The New Spirit of Discovery document lays out these priorities of implementation. NASA has been directed in very specific ways to reprioritize, with very limited latitude for interpretation. The result has been the movement of other science activities (e.g., SEU) to the right and on a fixed income. JWST is protected because the Administrator named it- it has high priority at the Agency level. This is not a science-driven vision. Aeronautics is still an integral part of NASA, but it draws about $1B per year (Code R). The fate of ISS after 2017 is unknown. Crew Exploration Vehicle (CEV) costs are uncertain and may become very inflated. Historically, science dollars have never been sacrificed to develop human space flight capabilities. Dr. Weiler will have the answers to some of these uncertainties. Dr. Kinney reminded the subcommittee that science has never been a top goal at NASA, but nonetheless scientists have always done very well at the Agency. Dr. Weiler manages the funding aggressively and keeps missions healthy and viable. What SEU science programs really need are augmentations- BE is still in the budget as a line item.

BE has selected mission concept studies and made selections in November. Funding has been initiated for 10 proposals. A SEU roadmapping workshop is planned for December to coordinate with an Origins workshop. Ten proposals have been selected, including five Dark Energy Probes, two Black Hole Finder Probes, and three Inflation Probes. An interim report is due in December 2004. The Joint Dark Energy Mission (JDEM) is the Dark Energy Probe and remains a high priority for NASA and the Department of Energy (DOE). NASA and DOE will jointly appoint a Science Definition Team (SDT). Next

steps for the Inflation Probe include following the recommendations of the Interagency Working Group on a Physics of the Universe report to develop an NSF/NASA/DOE roadmap on the future of Cosmic Microwave Background (CMB) research.

Space Science Vision Mission goals include refining the understanding of possible future missions for scientific and programmatic planning within OSS. Seventeen cases have been solicited; among these are the Big Bang Observer, Black Hole Imager, Life Finder, Far Infrared and Submillimeter Interferometer. Fifteen proposals have been selected for 12-month studies. An interim report is expected from study teams at the SEU Roadmap Workshop in December 2004.

Dr. Hertz invited solicitation of new subcommittee members as SEUS members rotate off. SEUS meetings have been set for July 26-27 (in San Diego) and November 8-9. Recommendations from the SEUS July and October 2003 reports were reviewed. In response to a remark, Dr. Hertz assured the subcommittee that the SEU does not raid the R&A budget to save projects, contrary to the community's evident perception.

JDEM arguments and budget difficulties were delineated; SEU will advocate the best program it can get funded. The upcoming BE meeting was briefly described [May 12-14 at the Stanford Linear Accelerator (SLAC)]. A question was raised concerning how the budget building process will change in response to the new vision. Dr. Hertz stated that SEU does not directly support the President's vision; therefore SEU must make the argument that it has important and compelling science. SEU will lay out its highest priorities for science and make a good case for them within the Office of Space Science (OSS). Technology development for future missions (Code R) is being seriously affected by these changes. OSS does have a vision for technology development and Code R has been greatly changed. A new Enterprise (Code T) now supports technology development. Code T is still finalizing its plans for its budget. This is an agenda item for later in meeting. It is not known whether the White House will take an active role in managing the NASA budget (they usually don't). SEU can only work hard to advocate its program.

Joint SEUS and OS Session

Dr. Hertz reminded members that Standard Form 450 is due before the end of February. Completed forms should be sent to Marion Norris. Two new Origins Subcommittee (OS) members, Anne Zabludoff and Victoria Meadows, were welcomed, and James Larkin and William Oegerle were bade farewell.

A&P Director's Report

Dr. Anne Kinney, Director of the Astronomy and Physics Division, presented an overview of A&P activities. She noted for the benefit of OS the objective "conduct advanced telescope searches for Earth-like planets and habitable environments around other stars" is in the President's vision. Dr. Kinney agreed that the exploration veneer should not be cast on the SEU; it has its own strengths, but it must take into account the need to co-exist with the President's vision. The Enterprise is examining ways to extend the operational life of HST without a service mission and is starting to address means of de-orbiting the craft via an autonomous rendezvous [a request for information (RFI) is

now on the street]. Advice from the Bahcall report has been superseded by the Presidential directive. SM-4 is still considered the highest science priority and was presented as such by the NASA Advisory Committee (NAC) to NASA Administrator Sean O'Keefe. The decision to cancel SM-4 was a hard decision but the right one. SEU difficulties concerning launch delays were reiterated.

GLAST has passed confirmation review to enter phase C/D. Space Interferometry Mission (SIM) and JWST System Requirements Reviews (SRR) have been completed. The SEU recently had an impromptu press conference on HST dark energy results; it provided better informational access for newspapers than a Space Science Update (SSU). Spitzer was launched in August and first images were released in December; a meeting in Pasadena is being prepared to present first-wave results. Other SSUs include Rossi X-ray Timing Explorer's (RXTE) cosmic speed limit on pulsars, HST's oldest known planet, and Chandra results such as black hole sound waves and destruction of a star by a black hole. NASA should think about conference calls as a second information dissemination venue and should also increase web access to science results. Video streaming for educational purposes should also be made more widely available. Reporters have limited budgets and would benefit from web access. NASA needs to be nimble about the way news is disseminated. There was an admonition from a subcommittee member to not allow media to dictate what is important and interesting science (i.e., the lure of black holes versus boring neutron stars). This issue was considered out of the control of NASA scientists- NASA's challenge is to prime the pump to create newsworthy items. A distinction was made between disseminating news rather than educational material. The SSUs are just a small part of how NASA publicizes its activities. There are other venues. There is an effort currently under way to educate science writers on upcoming BE subjects.

GP-B's upcoming launch was briefly discussed. Swift's launch in September 2004 is of some concern. Operating missions are all green. The A&P mission status is very good on the Origins side. A primary concern with SOFIA is being addressed with an overall evaluation. The Keck Interferometer is still red on legal issues; there is cautious optimism on resolving these. SIM and JWST have seen great progress in the last 6 months. The SEU mission status is variable. Herschel has purely monetary problems at present. International partnerships with European Space Agency (ESA) member states, in particular, are under scrutiny and are being pursued in good faith. The division is struggling with the management of LISA to create a truly viable management structure. Research Opportunities in Space Science for 2004 (ROSS-04) is out on the street- due dates for different disciplines were displayed. Guest Observer (GO) programs were reviewed and described as healthily subscribed. The R&A budget history was reviewed- it was noted that since 1985 it has increased threefold, with the increment coming largely from increases in data analysis and Theory. Dr. Richstone observed that the CAA perceives R&A funding as flat. There was some disagreement about real dollar growth in Theory. The suborbital line seems to be decreasing. In 2004, A&P is giving away $160M for peer-reviewed programs, a healthy sum.

Key division issues are the launch of GP-B, HST optimization and life extension, optimization of HST science program, planning and implementation of HST de-orbit, delay of the Swift launch, the future of SEU, and roadmapping activities in the context of the new vision. The Vision Missions concept studies have been announced and Origins Probes concept studies call for proposals is on the street. Mike Moore delivered some thoughts on the intent of the RFI on HST, part of which is to discover trade space in how to deal with the de-orbiting process. The goal is to have a system that doesn't care what the HST is doing because we could have a short circuit tomorrow. We don't want to terminate HST while it is still functional. The RFI does include plans for robotic life extension. Can technical issues be ameliorated with more money? As always, money will go to the highest priority mission. The overall budget for HST de-orbit project to about $380-400M. There are estimates of $700-800M. The greatest risk lies in making too rapid a decision for the requirements for HST management. Skepticism was expressed about a relatively low-cost robotic servicing mission. NASA must pay the whole freight to de-orbit HST. Dr. Kinney reminded the subcommittee that as the population of Earth grows, the risk of casualties related to debris impact grows. The Enterprise that launches the mission is responsible for safe de-orbiting technologies, despite the fact that this capability is needed across the NASA Enterprises. It was recognized that the ISS also requires a controlled de-orbit and it has a propulsion module to enable this. An animation of the JWST deployment was shown.

A&P Technology Requirements Survey

Dr. Melvin Montemerlo presented the results of a request for a listing of enabling technologies for Code S/Z, and technology development strategies. The documents are the *A&P Technology Development Strategies*, and the *A&P Enabling Technologies For Future Missions/SEU and OS Themes* (both distributed). These surveys should help the roadmappers take the technology requirements into account as planning progresses. These documents will not be discriminators for selection. The technologies called out will be high priority, but technologies not included will not be rejected out of hand. It is intended to be a helpful document and not a limiting or threatening document. The Spacecraft Technology Program History (began as Code R) was briefly reviewed, noting that changes in Code identification have been numerous. Dr. Montemerlo requested feedback from OS and SEUS on the accuracy and utility of the survey results.

The newly formulated Code T plans include a contractor review of all Code R Space Technology tasks in early March 2004. Code T will then determine what to continue- the timing of this decision is not known. For the first time, the technology program is in an Office that is responsible for its own projects, including vehicles and missions. Code T is not an Institutional Program Office and does not have responsibility for Centers. Boundaries have not yet been defined. Code S and T have divided responsibilities for the lunar mission, for instance. Restructuring is important for long-term science; these concerns should be taken to the NAC.

Committee members endorsed the survey effort and encouraged Dr. Montemerlo to consider information technology/software needs.

Discussion (Explorer Program)
Dr. Paul Hertz, Explorer Program Scientist, led a discussion on the impact of the new vision on the Explorer Program. It cannot carry out the program that was planned. Dr. Ed Weiler will be asking for advice to send to SScAC. Plans prior to the FY05-09 budget were compared to current plans. There has been a significant decrease in the outyear budget. There is no impact on already selected missions, but new missions will be difficult to start. Option A is to proceed as planned and downselect to 2 SMEXs in November, entailing a 9-12 month launch delay, and delay a Medium-class Explorer (MIDEX) Announcement of Opportunity (AO) by 18-24 months. Option B is to downselect to one, and with a lesser delay for a MIDEX AO. In addition, if EUSO is cancelled, there will be a favorable impact on the schedule.

The Option A/B decision is a programmatic decision with science goals uppermost in mind. The health of the SMEX program is good; it attracted many more category 1 proposals than could be accepted. NASA is committed at some level to the SM-4 instruments; the cost of keeping those instruments in storage is small and falls under HST. They can be competed in the future for other MIDEXs. It was a $200M investment that should not be wasted. A subcommittee member felt that a good decision about options was not possible without discussing SM-4 instrumentation. It was suggested that NASA ask ESA to consider these instruments for use in a low-cost mission. The five selected SMEXs are DUO, NuSTAR, JMEX, IBEX, and NEXUS

It was suggested to delay this decision until after November 2004. The downselect decision will be made in November, but if the Explorer budget were to be restored, the decision could be made sooner. In this light, one may expect that the Federal budget will be disposed by Congress by February 2005 at the earliest.

Lunch Presentation- Chandra Science Results
Dr. Harvey Tananbaum, Director of the Chandra X-Ray Center, presented recent science results from Chandra.

Ethics Briefing for Special Government Employees Serving on NASA Advisory Committees
Mr. Andrew Falcon, Attorney in NASA's Office of the General Counsel, reviewed the rules governing special government employees, defined as anyone who is retained, designated, appointed or employed to perform temporary duties, with or without compensation, for a period not to exceed 130 days out of 365. The statute covers advisory committee members with ensuing post-employment restrictions. Special Government Employees (SGE) ethics rules are based on the principles of public service as a function of public trust, and those who serve may not have conflicting financial interests, may not improperly use nonpublic information, and may not incur the appearance of impropriety. The statute prohibits representational activities before the Government. The prohibitions apply to SGEs only if the matter involves parties (contracts), the SGE was personally and substantially involved in the particular matter, and the SGE served more than 60 days in the previous 365, and the matter is pending before the same agency. The term "representational activities" means serving as agent (acting on behalf of another) or

attorney. The government is considered as the Executive branch or the Judicial, not the Legislative. The financial conflicts statute prohibits involvement in a particular matter in which the SGE, employer, spouse or dependent child has a financial interest. This affects discussions of NASA programs in that an SGE subcommittee member must recuse him/herself from NASA discussions if they involve the member's employer (e.g., HST). However, speculative matters are exempt from this consideration. All members get GO funding; how does this fall under the statute? If the recipient of a GO grant doesn't appear to have interest in a particular matter, there is no conflict. There was considerable discussion of how members might be seen in conflicting positions due to individual involvement with NASA-funded institutions, projects or programs. Anyone involved with the SMEX missions, for instance, should not participate in Explorer discussions. Another example would be a member involved in phase B studies for JWST being prohibited from discussing JWST matters. Most committee discussion revolves around science requirements and not particular matters, *per se*.

Post-employment restrictions permanently prohibit a former employee from making, with intent to influence, any communication to the United States, on behalf of any other person, in connection with a particular matter in which the United States is a party or has a substantial interest, if the employee was personally and substantially involved in the matter. A listing of NASA ethics officials was provided and members were reminded that the Executive Secretary also functions as a bulwark against ethics violations.

Associate Administrator's Report

Dr. Ed Weiler, Associate Administrator, presented an overview of Space Science and the President's Renewed Spirit of Discovery. The new vision was developed by the White House, Office of Science and Technology Policy (OSTP), NASA, and other executive branch agencies; the final decision was made by the President and was made prior to successful Mars landing. The basic tenets were reviewed.

Four key tenets of the President's new lunar and Martian initiative were presented:

- NASA will implement and sustain an affordable robotic and human program to explore the Solar System (SS) and beyond.
- NASA will extend human presence across the SS with a return to the Moon by 2020.
- NASA will develop innovative technologies, knowledge and infrastructure to support exploration.
- NASA will promote international and commercial participation in furthering the goals of the exploration initiative.

The vision recognizes the value of robotic and scientific exploration. Human explorers will follow robots. Breakthrough technologies will be sought and planetary resources investigated. If there had been no new vision, OSS's budget would have been devastated. NASA's new exploration plan is affordable in the near- and long-term. The Presidential Space Commission has been appointed to examine the implementation of the vision. NASA has already begun to reorganize to implement the vision. The new Office of Exploration Systems (Code T) will provide guidance to OSS. The first CEV test flight is

scheduled notionally for 2008-9, a "Safe on Mars" mission for 2011, and the Jupiter Icy Moons Mission (JIMO) for 2015.

OSS implications of the new vision were presented. OSS has a new theme of lunar exploration. An AO must be out in May for the 2008 lunar orbiter. Work is in progress to narrow down requirements. Initial requirements may concern the need to digitally map the moon, a gamma ray spectrometer for resource exploration, and an altimeter. This will be a requirements-driven AO (instrument AO). Some budget will be set aside for data analysis. There will be a lunar exploration roadmap. The first mission requirements are top priority, with architecture to follow. The Sun-Earth Connection (SEC) budget is stable, as is SEU, however both budgets had been growing before the vision was announced. The engineering aspect of Prometheus has been moved from Code S to T. JIMO science will stay in OSS. The Mars program remains unchanged.

Lunar exploration has been posited as a technology proving ground. NASA is going to the Moon to learn how to do science on Mars. There is no move to establish a permanent presence on the Moon. Budget particulars were reviewed. Space Science themes supporting exploration include Origins, solar system exploration, and Mars and lunar exploration. NASA should be talking about a nuclear-powered rover for the first lunar mission instead of a lander. LISA has been delayed: Dr. Weiler announced his intention to try to remove some of this delay within OSS. Some additional funding for GP-B, GLAST and Swift will be made available. Solar Terrestrial Probes have been significantly reduced and stretched out, although there remains concern about the human/space interface above the altitude of the Van Allen belts. Some center construction projects have been delayed. The Mars website has had 6.6 billion hits. Mars highlights were presented.

A telescope on the lunar South Pole was considered impractical due to too much thermal variability and dust. Contamination issues are being considered by the Planetary Protection Officer (John Rummel) to avoid forward or backward contamination. There are also United Nations (UN) requirements governing planetary protection. Exploration of lunar resources will not be an OSS activity. There is still some science to be done on the Moon, but it may not be National Academy of Sciences (NAS)-level. Strategic planning should not affect most programs, but will stretch out priorities in space plasma physics. The value of the science should be argued on its merits, and should not be countenanced in the guise of explorations. We should make the effort to get Einstein probes back into the budget and resurrect Solar Probe. The Explorer program probably can't be changed. As long as NASA produces, it will be hard to justify cuts to Space Science. Right now NASA is riding a crest. There is no necessity to reinvent BE; it remains a high priority for the NAS.

A subcommittee member commented that there does not seem to be a good strategy in place to get low-technology readiness level (TRL) instruments into place to fulfill the mission imperatives. Dr. Weiler replied that Harley Thronson is doing his best to address this. The question that must be asked is: Is R&A addressing this sufficiently? Each division director must determine this. Code S takes over at around TRL 4 or 5. The value

of sending a human to the Moon was questioned. The Moon is useful as a practice run for Mars. A human-serviceable telescope initiative at Lagrange Point 2 (L2) is still under consideration. Terrestrial Planet Finder (TPF) should be pursued. The new vision affects the interagency dark energy initiative (JDEM); however all agree that a dark energy mission is very important. Dark energy is still a high priority at DOE. The ISS strategy reflects its new life sciences focus, the primary reason it is being retained. Until the CEV can team up with Soyuz, a significant crew increase cannot be achieved (until about 2010).

SEUS Session

LISA Project Status

Dr. Bryant Cramer, LISA Project Manager, presented an update on the status of the LISA mission. The budget is less than anticipated, resulting in milestone delays, with a near-term focus on critical long-lead work. Life testing of microthrusters should not be delayed, and high-risk areas go to the top of the list after long-lead work. Budget guidelines may vary over the next few months. Current re-planning identifies prioritized contingencies to accommodate changing guidelines. The LISA management schedule was reviewed. The schedule is being replanned due to budget issues; therefore LISA will slip about a year. A primary concern is to sync up the schedule with Europe. Greater reliance will be placed on early ESA definition studies, which may work to buy back some schedule. NASA and ESA have been discussing how to integrate the payload onto the spacecraft. ESA has proposed to swap payload and spacecraft responsibilities. In such a scenario, ESA would be responsible for the development and integration of the payload, and NASA would be responsible for the spacecraft. OSS is seriously considering the proposal. LISA science team activities included as major topics a report on Extreme Mass Ratio Inspirals, and a discussion of important developments in technical aspects of arm-locking and time delay interferometry.

Integrated Technical Teams (ITTs) have been formulated to produce detail requirements for the Interferometry Measurement System (IMS), Disturbance Reduction System (DRS), and Constellation. Technology development progress was itemized. For the gravitational reference sensor, a development plan is in place, and the architect will be sole-sourced to the ST-7 developer. Microthrusters will be developed as colloidal thrusters from a US supplier. Disturbance reduction system control laws are in development. Integrated modeling activities include detailed thermal analyses, acquisition simulation, and scattered light.

LISA Pathfinder, the technology validation mission for LISA, has been endorsed by ESA in November 2003 and was scheduled for a new start in 2004. Instrumentation was shown. In summary, good progress has been made in technology development. Pathfinder is building hardware, the LISA Mission Requirements Document has been released, and management is being streamlined. Despite budgets, LISA is moving forward. The mission is trying to understand how it can best deal with budget realities. Strategies to buy back schedule lie in understanding resources on both sides for technology investment. When do science requirement decisions need to be made to avoid impact on

schedule? The goal is to try to push the technology effort, make a trade study, cost it, do the cost-benefit analysis, then bring it back to headquarters (HQ).

Constellation-X Update

Program Manager Dr. Elizabeth Citrin presented an update on Constellation-X (Con-X), a high-throughput large area X-ray spectroscopy mission to study the effects of strong gravity near black holes. The mission summary schedule was reviewed. FY04 funding was reduced (from $23.5 to $10M), and all major procurements were put on hold. Funding allocations were revised to keep core teams in place, and funding was prioritized to optics. The five-year budget projections are well below levels anticipated. FY06 funding dropped precipitously and the program is working with HQ to rectify some of the adverse impact. The project response has been to work to revisit mission reconfiguration, including launch vehicle options and packing strategies. Current requirements and goals will be reviewed in light of progress to date and recent science developments. International partnerships will also be explored to ameliorate negative budgetary impacts.

The mission reference configuration was presented in illustrated form. Each technology has a development plan. Optics has been a major area of focus and progress; the substrate slumping process was described. Mirror quality improvements were graphically presented. As substrates improve, the project may reach a point where it no longer has to replicate, which will save time and money. The microcalorimeter technology roadmap was presented. Progress in the development of the transition edge sensor (TES) was described; reduction of noise is a primary goal. The first 8x8 arrays have been produced. The National Institutes of Standards and Technology (NIST) is also looking at a TES array with a different absorber. The reflection grating spectrometer concept was summarized, along with its technology development roadmap summary. Off-plane gratings are also being considered. A resolving power of 500 has been demonstrated with an off-plane grating and a 3 arc minute telescope; the performance is expected to improve with a flight-specification 15 arcsecond mirror.
Next steps for the RGS program are investigating polarization for off-plane gratings. Hard X-ray telescope (HXT) technology development was described. Glass segment mirror prototypes have been produced. Assembly error budgets do not quite add up. Initial efforts have been made in nickel coatings. In summary, progress to system-level milestones has been greatly slowed, but the time will be used to optimize the mission. Technology development monies may be available from old Code R/new Code T sources; the level of budget detail has not yet been reached. There is a possibility to get to system level testing by 2007. Dr. Hertz remarked that the current profile is a stay-alive technology development ploy. The challenge is to make assumptions for the outyears, and try to make a case for an earlier launch date. European partnering discussions have not been productive thus far; however discussions have begun for joint approaches for future missions- the next year is a good opportunity for both sides to work out the issues. Dr. Hertz noted that Dr. Citrin is leaving the project; he thanked her for her efforts.

Discussion

Dr. Kolb assigned topics of concern to members, adding that SScAC action issues should be sharply distinguished from other issues.

General status of BE
BE is down to one partially funded mission. It is apparent that Con-X is not funded as a near term flight project. The Einstein probes are beyond the budget horizon. The theme needs to repackage the most exciting aspects from BE. The most useful thing for NASA is to state that BE is still very compelling and the most important thing NASA can do outside the context of the exploration strategy. LISA should also be funded so that it can be realized on a more near-term schedule. The most painful disappointments are LISA, Con-X and the Dark Energy mission. Another disappointment is the Explorer program. It is important that the strongest arguments for the program be retained- the President has not said exploration is the only thing NASA can do. It would be a bad strategic move to define BE as exploration. The importance of dark energy should be re-stated; it has been endorsed by the science community. Ed Weiler has underscored the importance of BE as well. The dark energy probe could also be shared by other agencies. Black holes, Big Bang and dark energy, as well as fundamental physics, remain strong arguments for BE. NASA should capitalize on the public's intrinsic interest in Einstein. Dr. Hertz suggested that SScAC endorse the notion that space science should be broader than planetary science. As a matter of principle, NASA should be doing basic science.

SEU status
SEUS should endorse the idea of doing a science definition team (SDT) and science concept studies for JDEM now. Behave as if there is a remedy for a dark energy mission in the pipeline. Position SEU such that it would benefit from a rebalancing of the budget and be ready to buy back time. Next steps for a Black Hole Finder probe should be identified.

A&P division status
It was perceived that Dr. Kinney seemed to want a discussion on R&A. SEUS would not be the first to advocate more money for the R&A program; the value of the program must be explicitly stated. NASA also funds scientists through other venues such as the GO and foundation science. Others felt that R&A should be called out as a key component for funding science. This administration recognizes that we must prepare the workforce for the 21st century (no astrophysicist left behind). SEUS affirmed Kinney's efforts on behalf of the R&A program. Ed Weiler holds his directors responsible for supporting the mission. The SRT is the seed corn for future missions.

Comments on the cancellation of SM-4-metrics will not be helpful. SEUS can say that HST has a tremendous amount to contribute to SEU science, and every effort should be made to capitalize on its science. It should be made clear that it will be a great loss to SEU science and that SEUS is disappointed. SScAC should be advised to safeguard science priorities, and not subordinate them to exploration. If an autonomous mission for de-orbiting is mentioned, it should be mentioned in the context of the de-orbiting needs of other agencies. There is no need to state a need for an autonomous service mission. HST's science return should be maximized over its remaining lifetime.

A&P technology survey
Informational technology (IT) should be mentioned. SScAC is already aware of the need. The IT needs can be better articulated, and should be stated as explicitly as technology needs. Dr. Kinney can be encouraged to develop A&P plans for IT needs. The technology survey document is very useful and should be updated periodically as the roadmaps are updated. Modeling software can also be considered an enabling technology.

Explorer
One issue is the budget, and the second is the Option A/B plan. No one feels the budget hit was a good idea. SEUS should strongly encourage a budget increase to help support a frequent flight rate for a good science return, quick response, and to train the next generation. The Explorer program historically has achieved frequent flight opportunities, and this should continue. There should be 2 SMEXs for fairness. There is also community interest in future access to space and there are good proposals already on the table. Option C is to go with Option A and then seek to get funding restored. The most likely Explorer selection outcome would be one SEU and one SEC. It was noted that Dr. Weiler had favored a downselect to one SMEX.

February 25, 2004

Joint SEUS and OS Session
Dr. Kinney was called out of town and will be unavailable for the report to the director. Posters on the upcoming BE meeting were distributed, an email having also been sent out on the subject. An announcement was made concerning the Chicago workshop to foster broader participation in NASA space science programs. The purpose is to bring minority scientists into the space science community and develop professional and mentoring relationships. Discipline scientists have been asked to contact interested colleagues.

Research and Analysis (R&A) Update
Dr. Jeffrey Hayes provided an update on R&A activities, including Theory, GO and Archives. Traditional elements of the program are ultraviolet (UV)/optical detectors, infrared (IR) submillimeter, origins of solar systems, high-energy astrophysics, balloons, sounding rockets. Data analysis and theory elements include ADP/LTSA, ATP, and BE Foundation Science (BEFS). BEFS contains all elements, not just Theory. The ROSS schedule deadlines were presented. Delayed grant notifications in OS/SS have been due to budget uncertainties and understaffing problems. The A&P policy for GO funding programs is to support users of NASA assets in the analysis of their data- the mission set includes HST, Spitzer, and Chandra. FY04 funding levels for various continuing and new awards were presented. The total is $164M for FY04. Senior Review guidance largely determines the distribution of dollars and the quality of the proposals. There is some flexibility to rebalance the distribution once the budget is in place in response to quality pf proposals as determined by peer review. Operations are not part of this budget; it also does not include legacy teams. A&P has responded to calls for more Theory support, and added new funding to HST, CXO, SST, and BE (about $13M, in full-cost accounting dollars). This represents a significant increase in Theory funding. In addition, there are other sources of Theory funding scattered throughout OS and SEU. Skepticism was

expressed about the full amount of funding, impacted in part by the costs for NASA civil servants. The quality of the grants (in terms of proportion one-year versus three-year grants) was debated. The Decadal Survey recommendation was to associate Theory programs with missions at appropriate stages of development, and NASA has answered this recommendation (e.g., in early BE and TPF). A breakdown of funding was presented. FY04 funding levels for the Archives is about $25M. The community does not fully understand that Theory is distributed so broadly among programs. ROSS has been rewritten to deal with this question- it includes an explicit but conservative representation of new monies available each year. Dr. Richstone remarked that Theory has been rated so highly because Theory papers have been giving extraordinary bang for the buck, in extending the value of missions and providing a pathway for future missions.

High Altitude Sounding Rockets (HASR)

Dr. Philippe Crane introduced a briefing on the sounding rocket program, an important part of the R&A program. Almost all flying satellites have detectors that were built and flown in this program. Dr. Mary Mellott, Sounding Rocket Program Scientist, announced that a significant new capability at Wallops can be developed in very high-altitude, long hang-time rockets. The new budget has adversely impacted the development of this new capability in sounding rockets. Dr. Mellott asked for SEUS advice on rebalancing the budget to support the HASR program on its intrinsic merits. Dr. Philip Eberspeaker continued the presentation. The sounding rocket program offers unique opportunities for low-cost, fast-turnaround, focused scientific research, platforms in space for testing and developing new technology, and hands-on training for young researchers. A typical flight profile is about 700 km altitude and 1000 km range. Vehicles include the Terrier Malemute, Nike Orion, Terrier Orion, and Black Brants IX and XI. Experiments span the disciplines from astronomy through plasma physics, air sampling, and atmospheric entry vehicles. The program leverages multiple sources (e.g., Navy) for funding. The HASR is the next generation rocket, providing a 1000-lb total payload (700-lb science instrument), 50-inch fairing, 3400-km apogee, and 40-minute observation time. The cost per mission was estimated at $5M or less per vehicle, plus operations ($10M total). A tentative plan was to launch one HASR every one or two years while maintaining the smaller rocket program. This plan is not supported by new budget projections.

Primary reasons to support the high-altitude sounding rocket program are:

- 40-minute observations are better than 5-minute observations
- Apertures closer to 1m instead of 0.4m
- Low cost compared to satellites
- Recoverable payload
- Time to develop payload and do science is less than 10 years
- Provides training
- Mitigates development risk
- Ability to “cherry pick” discovery space

Some SEUS members felt the cost-benefit ratio was disadvantageous and that the instrument-testing and training argument (more flight opportunities) was stronger than the science argument. The program was regarded as more pertinent to SEC or geospace

science, not to SEU or OS. Go all the way and make the HASR a new Pegasus vehicle with orbital capability? The program may have some future access to surplus Patriot vehicles. Colin Norman- has been a great program over the last decade, valuable for providing experience. Dr Spergel suggested that the APWG should evaluate the program.

AAAC report

Dr. Hertz presented a synopsis report from the AAAC, a joint NASA/NSF advisory committee on astronomy. Robert Gehrz is the outgoing Chair and Garth Illingworth is the Chair-elect. AAAC endorsed JWST, expressed concern for BE and had a lively debate about SM-4. AAAC also endorsed the astronomy and astrophysics supported activities in the DOE Office of High Energy Physics. An x-ray astronomer was suggested for the AAAC. There may be a need for a gravitational wave scientist, however, as there are overlaps between NSF and NASA in this area. The AAAC does implicitly endorse the Inflation Probe because of its support for the future of CMB research roadmap. The SM-4 discussion is still under way, but the AAAC is expected to point out the science losses incurred by the loss of the mission.

SAWG report

There were no comments- the report is available on the Web. A request was made for hard copies of the report.

SEUS Session

Balloon Program Update

Dr. Vernon Jones presented an update on the balloon program, which provides low-cost access to space at altitudes up to 160K feet, and niche science investigations that can be done above 99.5% of the atmosphere. The program also makes possible observatory-class payloads with advanced technologies and large aperture mass, technology development and flight validation for future space missions, and cutting edge science in 10-20 day missions. The program must increase its flight rate; it has been decreasing linearly over the past 4 decades, although flight durations have been increasing. There is insufficient funding for building payloads and for operations. With the availability of the new launch vehicle in FY04, 40M-cubic-foot balloons were introduced for LDB flights in Antarctica. The ANITA experiment for neutrino-based observations was described. The program is at a crossroads. Changes since the Columbia accident justify a new plan for balloons. The plan is to focus a strategic balloon plan on both payloads and operations, increase the number of conventional and long-duration balloon (LDB) flights, and complete the development and demonstration of ultra-long duration balloon flights (ULDB). The "Big 60" flights to 160,000 ft should enable UV observations. Flights in Antarctica are limited by an insufficient NASA budget, inadequate logistics support from the NSF/Office of Polar Programs for more than 2 flights per year, inherent limitation of austral summer length, the need to recover balloon carcasses to meet EPA constraints, and some self-imposed limitations due to operations policy. Additional resources are needed from NASA/OSS. A modest budget line could double or triple the LDB flight rate. More logistics support is needed from NSF/OPP. Resources are also needed to improve the recovery process, such as an additional aircraft. Procedural changes in operations could increase efficiency. One option is to let balloons "fly till they die" if recovery is not

required for a follow-on science flight, (but there may be environmental concerns for this option). The strategic planning process is under way, with an Antarctica workshop planned for May 2004. The critical question is: Is there sufficient quality science available for justifying new payloads?

Plans for the ULDB Program Recovery were presented by David Gregory, Assistant Chief, Balloon Program Office. After a failure (failure to deploy and maintain pressure) of a balloon during a test flight at Alice Springs in 2003, some modifications in the design and fabric process have been made, including strengthening tendons that bear the load. Five test flights will be conducted this year. A 6 million cubic foot (MCF) balloon will be taken to Australia in December 2004, with a 21 MCF balloon to be flown in December 2005. Other studies are ongoing to mitigate clefting problems with balloon materials. Antarctica balloon operations were briefly touched on. A new facility is planned for completion by October 2005, with a two-payload (perhaps three) support capability.

SEU E/PO Update

Dr. Roy Gould, Director of the SEU Forum, presented examples of the many SEU education / outreach projects underway. With input from the SEU missions, the SEU Forum sets explicit, overarching goals for these projects that are reviewed by NASA every four months. These goals address the Forum's mandate for formal and informal education and public outreach. Activities are coordinated with the SEU missions through monthly teleconferences, meetings, and shared activities, such as the SEU "short course" for pre-college teachers, the Forum-sponsored WMAP national webcast, and the Forum-sponsored professional development workshop for SEU E/PO leads. The Forum also coordinates the many external audiences and organizations whom they serve. These coordination functions also are reviewed by NASA every four months. At present, the missions' E/PO programs are under no obligation to coordinate with this centralized NASA education effort.

There is very strong public interest in the SEU theme, as evidenced by presented quotations from participants in recent E/PO programs, and the Einstein centennial will provide further leverage to build on this interest. The goal is to reach a diverse audience in the pre-college population, and to supplement the dearth of astronomical knowledge possessed by elementary school earth science teachers. The Cosmic Questions National Exhibition is on tour through at least 2005, and it is a showcase for SEU science. It will have attracted 1 million visitors after its current venue. The SEU Forum has redone its website to reflect its focus on the Beyond Einstein theme. There is also an opportunity to reach the many amateur astronomers in the US, who typically do not have a strong interest in SEU science. The limiting factor in the classroom teaching of Big Bang theory is lack of professional development. Student interest in Big Bang cosmology is identified as high. Priorities are to develop the SEU story and unify with the other science themes, and provide students with better tools for study.

Mr. Paul DeMinco, SEU Theme Manager at GSFC, presented a summary of planning for E/PO in the BE program. The results of an external review of OSS education programs

provided a starting point for analysis. The review suggested that teachers have trouble getting the data they need to present BE concepts. The science message rather than the mission must be the obvious focus. There are also challenges peculiar to teaching BE physics that need to be addressed.

A Framework Initiative has been undertaken by OSS to identify issues by grade level (K-12). The AAAS has a project 2061 Atlas that reflects the desired ideas that would be expected in 2061. The Atlas is weak in presenting SEU science and there is an opportunity to rectify this. A Fall 2003 workshop identified middle and high school science as good targets. National science standards are not followed consistently among states. The OSS Framework will provide guidelines to deal with this inconsistency. Another target of opportunity is the two-year college, because many science teachers begin their education there. There is a potential to collaborate with the National Science Teacher's Association and the National Council of Teachers in Mathematics in DC. Current initiatives with DOE include creation of a sustained collaboration in both the education and public outreach area. A science symposium to celebrate the Einstein centennial is under consideration. The theme is also collaborating with the American Association of Physics Teachers (AAPT) and the Navigator Program, leveraging existing efforts with community colleges and the AAPT. A new tool in outreach includes high-definition animation. Future activities include additional workshops, and development of a long-term plan that flows with the results of the Framework Initiative assuming the availability of Beyond Einstein funding.

R&A

The trajectory is in a positive direction, and it is nice to see Theory tied to missions, although it would also be desirable to see independent funding. Chandra seems underfunded compared to Spitzer; an explanation should be sought.

Roadmap Planning

Dr. Hertz presented the roadmapping strategy for SEU. A new strategic plan will be released in time for the next fiscal year announcement (FY06). The SEUS was asked to look to SEU goals and objectives before it is submitted for inclusion into the NASA strategic plan. The Strategy 2006 schedule was presented- the due date for the new roadmap is June 2005. In A&P it appears that OS and SEU situations are reversed from where they where 3 years ago. It is not necessary to re-create BE; the science is still compelling, and recent science results have affirmed its value. The plan is to simply to update and improve the document (particularly the Cycles of Matter and Energy portion). The results of the enabling technologies survey will be useful. A review of goals and mission will be completed by the next meeting (July 2004). Supporting activities can inform the SEU roadmap, including a JDEM SDT, a Balloon Program strategic working group, Einstein probes mission concept studies, and other studies as required. The roadmap team can be directed by the SEUS, supplemented with additional community members. A strawman schedule was presented.

Discussion
BE may cause a disconnect between the new vision and the OSS. Cycles of Matter and Energy could be tweaked to be more congruent with expected changes in the OS roadmap. At the very least, SEU should endorse overlapping interests in OS. It is important that the most compelling arguments for SEU science be retained. Dr. Cominsky expressed concern about Cycles of Matter and Energy prioritization if there is no money to support it. The second half of the roadmap should be as succinctly written as the first half.

E/PO
External review of outreach/education was discussed. Mr. De Minco would like to have a non-advocate review team to evaluate efforts. The SEU Forum budget is about $1M and prioritization is done with an education council that meets 3 times per year. Targeting textbook writers is being done, through the Lunar and Planetary Institute, and through the NSTA (to add websites to textbooks). PIs are also involved in education projects. Modest funding is available for these activities; E/PO is making do.

E/PO has demonstrated an impressive breadth of activities, but an absence of connection between activities and specific SEU missions. There is not a great deal of coordination and overview, and no overarching goal of E/PO. There is no support staff for E/PO at Goddard Space Flight Center (GSFC). Dr. White stated that from his perspective, E/PO is generally disconnected from themes without priorities being set, and that he would like to see the Forum re-competed or openly competed. The purpose of the E/PO forums is different from the mission E/PO purpose; forums were set up to be independent of missions; however there should be a better coordination process in SEU E/PO. SEUS should agitate for coordination, not direction. Coordination needs teeth, instead of "letting 1000 flowers bloom" (the latter approach has been criticized). There are no NASA coordinators to oversee PI-led activities. The forum should be used to articulate strategic direction for E/PO and ask that proposals address themselves to that vision. Dr. Hertz noted that the current system explicitly prohibits this. A coordination clause could be inserted into the new BE roadmap. The need for coordination should be emphasized in a letter. The outreach part of BE is crucial at this time. There is no funding for Einstein centennial E/PO activities at this time.

SEUS recognizes the impressive activity of E/PO but detects a lack of coordination, architecture, and overarching goals. Coordination of activities is desired, and SEUS would like to hear about how E/PO will respond to the near-term opportunity of the Einstein centenary.

Balloons
Rockets and balloons together should constitute a sub-orbital program. Are they trying to test the same thing? Is 15-20 launches the right number (a minimum of 20 balloons per year would keep the manufacturer alive). Are the criteria for payloads well-defined? The payload budget was seen to be the limiting factor that could be ameliorated by an augmentation in operations and science, however an augmentation needs a clear justification. The program must make a clear case that it is important to do ballooning. A

presentation from a balloon scientist was requested for the next meeting to help make the case. Aligning balloons with the strategic plan is a step in the right direction but not the final step.

BE bullets
The NASA Roadmap identified science goals of BE as being among the most exciting topics and have been endorsed across the board by the science community. The program should be restored to highest priority for funding. SEUS should unanimously endorse Ed Weiler's plan to make Einstein Probes one of his top priorities. Progress on LISA and Con-X should be accelerated as much as possible, with particular attention to JDEM.

A&P report
SEUS mourns the loss of SEU science that will occur when HST ceases operations. SEUS commends and endorses efforts to extend HST life and to maximize science return. NASA is encouraged to continue to explore options to restore the scientific loss.

Explorers
The Explorer program has been spectacularly successful, however the SEUS is disappointed in budget cut, and is pleased to see restoration after FY08 to restore the flight rate. SEUS recommend that 2 SMEXs be funded and MIDEX delayed as necessary. (The arguments for this recommendation are fairness, the "bird in the hand" argument, and the preservation of an option to pull back the schedule).

Technology
SEUS was pleased by the effort to identify enabling technologies. At the next meeting, SEUS would like an update about the interface between Code S and Code T, and how the agency will handle advanced technology development after the NASA reorganization.

R&A
SEUS applauds increased support in APD, encourages continued support of BEFS, and asks for an explanation behind the differences in funding for the various great observatory programs allocating funds.

Rockets
Rockets are important for training and testing technology but there was concern about the ability to figure out how to build larger rockets. SScAC should address the utility of the sounding rockets program. There is not much SEU science justification for HASR. Dr. Finn asked for clarity on the rocket's mission concerning SEU, how their budget lines up, and their historical success with SEU. What should be the criteria for developing a sounding rocket project? Should technology development be the sole reason? Goals for training and technology development must be identified. New Millennium is orbital in focus and rockets are suborbital. New Millennium is for developing general-purpose technology. Additional information on the role of rockets in technology development was requested.

LISA and Con-X
Dr. Cominsky remarked that is a good idea for Con-X to collaborate with the Europeans. Dr. Wright suggested a complete re-think on something that is too heavy to launch on one vehicle to meet Level 1 science requirements. There is plenty of time for a general re-evaluation. Dr. Finn felt that LISA has made a good response, particularly looking at activities to reduce future risk. Dr. Kolb noted that they seem to have made a decision to pursue one technology solution- this should be noted as a possible consequence of the budget. It might be too early to evaluate what ESA and NASA are going to do. At some point, financial and programmatic issues are going to force choices, but the choices will be carefully made as additional information comes along. The bottom line is that both missions are responding rapidly and appropriately; good technical decisions have been made. Con-X is organized well. Dr. Finn encouraged LISA to resolve management issues.

BE Roadmap priorities remain high, of which LISA and Con-X are an integral part. SEUS is impressed by the refocusing activity of LISA, pleased with technology development and ESA congruence, and looks forward to resolution of management issues. The budget for LISA is insufficient for healthy progress in the future.

The Con-X budget has been reduced 70% through FY09. This profile is not sufficient for a flight project and there is particular concerned about FY06 funding. Efforts to seek European partners, and a re-evaluation of mission configuration (i.e., number of spacecraft) were endorsed

Balloons
SEUS applauds the integration of balloons into the strategic plan. NASA should be thanked for maintaining the program. SEUS requests a crisp definition of the rationale for ballooning program.

Other matters
The agenda for next meeting was briefly outlined:

- GO program differences
- LISA management
- Code T
- Rocket program
- Einstein centenary
- Roadmapping
- LDB mission talk
- AAC report to Congress
- SAWG and APWG
- In-orbit checkout for GP-B?
  BE SLAC meeting results
- Herschel and Planck update
- Meeting of the clans
- Strategic planning big picture

Last thoughts
Dr. Ulvestad - Likes balloons as much as Con-X
Dr. Mundy - Balloons seem more sensible and cost-effective for SEU than rockets.
Dr. Hogan - Can you put people on Mars without microbial contamination? What of the ethics surrounding the treatment of humans on the way to Mars?
Dr. Heckman - It is good to take the high road on BE- it is an important battle and should be an essential part of NASA's mission.
Dr. Flanagan - What role will SEU roadmapping play, if any, in the strategic plan?
Dr. Cherry - Was intrigued to hear that the OSS strategy is to make the argument that SEU science is unique and compelling, treating this year's budget as an anomaly- hope it works.
Dr. Cominsky - It is better to have a budget line with no budget, than no budget line at all. Renewed in her fight for BE.
Dr. Dermer - The process looks strange, but it reaches a seemingly reasonable solution- within a year or two, things will settle down.
Dr. Finn - Was much more comfortable after hearing Dr. Weiler's presentation- he is a strong defender and advocate for science. There is a sense that new exploration is not the exclusive priority of the agency. Very concerned about losing Con-X in the short-term.
Dr. Wright - The budget uptick in 2009 seems miraculous. Assuming the exploration initiative goes forward, the budget will only worsen. Always thought we would lose 75% of Con-X.
Dr. Yorke - The meeting has been overshadowed by the new vision. There is significant negative implication for SEU and for peer-reviewed science in general- hope it will be corrected in the near future.

Dr. Kolb thanked the SEUS members and adjourned the meeting.

Appendix A

STRUCTURE AND EVOLUTION OF THE UNIVERSE SUBCOMMITTEE (SEUS)
February 24-25, 2004
University of Maryland Conference Center, College Park, MD

MEETING ATTENDEES

Subcommittee Members:	
Kolb, Edward "Rocky" *(Chair)*	Fermi National Accelerator Laboratory
Cherry, Michael	Louisiana State University
Cominsky, Lynn	Sonoma State University
Dermer, Charles	Naval Research Laboratory
Finn, Lee Samuel	Pennsylvania State University
Flanagan, Kathryn	Massachusetts Institute of Technology
Heckman, Timothy	The Johns Hopkins University
Hertz, Paul *(Executive Secretary)*	NASA Headquarters
Hogan, Craig	University of Washington
Mundy, Lee	University of Maryland
Ulvestad, James	National Radio Astronomy Observatory
Wright, Edward	University of California, Los Angeles
White, Nicholas	NASA/GSFC
Yorke, Harold	NASA/JPL
NASA Attendees:	
Bennett, Chuck	NASA/GSFC
Blackwood, Dan	NASA Headquarters
Burch, Preston	NASA/GSFC
Capps, Rich	NASA/JPL
Citrin, Liz	NASA/GSFC
Crane, Philippe	NASA Headquarters
DeMinco, Paul	NASA/GSFC
Devirian, Mike	NASA/JPL
Eberspeaker, Paul	NASA/GSFC/WFF
Frogel, Jay	NASA Headquarters
Gehrels. Neil	NASA/GSFC
Geithner, Paul	NASA Headquarters
Grady, Jean	NASA/GSFC
Greene, Tom	NASA Headquarters
Gregory, David	NASA/GSFC/WFF
Hasan, Hashima	NASA Headquarters (OS Executive Secretary)
Hayes, Jeffrey	NASA Headquarters
Hy, John	NASA/JPL
Kinney, Anne	NASA Headquarters
Kniffen, Donald	NASA Headquarters
Jones, W. Vernon	NASA Headquarters
Kaluzienski, Lou	NASA Headquarters
La Piana, Lia	NASA Headquarters
Leisawitz, David	NASA/GSFC
Leckrone, David	NASA/GSFC
Mather, John	NASA/GSFC
Mellott, Mary	NASA Headquarters
Meyer, Michael	NASA Headquarters
Montemerlo, Mel	NASA Headquarters
Moore, Michael	NASA Headquarters

Nelson, Robert	NASA/JPL
Norris, Marian	NASA Headquarters
Oegerle, William	NASA/GSFC (OS member)
Pfatt, Robert	NASA/GSFC
Pierce, David	NASA/GSFC/WFF
Pilcher, Carl	NASA Headquarters
Purdy, Craig	NASA/GSFC/WFF
Rumnegar, Bruce	NASA/ARC
Salamon, Michael	NASA Headquarters
Shelmattes, Robert	NASA/GSFC
Six, Frank	NASA/MSFC
Smith, Eric	NASA Headquarters
Trotta, Ann Marie	NASA Headquarters
Van Zyl, Jakob	NASA/JPL
Varsi, Giulio	NASA/JPL
Wainio, Lisa	NASA Headquarters
Weiler, Ed	NASA Headquarters
Wilkinson, Chris	NASA Headquarters
Wiseman, Jennifer	NASA Headquarters
Woods, Dan	NASA Headquarters

Other Attendees:

Beres, Kathleen	Orbital Science Corporation
Conte, Dom	Spectrum Astro
Cullen, John	Senate Commerce Committee
Davidoff, Larry	Boeing Corporation
DiBiasi, Lamont	L. DiBiasi Associates
Ferguson, Harry	Space Telescope Science Institute (OS member)
Gould, Roy	Smithsonian Astrophysical Observatory
Green, James	University of Colorado (OS member)
Harrison, Steve	NGST
Harwit, Martin	Cornell University
Herman, Daniel	Brashear LP
Hewitt, Jacqueline	Massachusetts Institute of Technology
Hillenbrand, Lynne	California Institute of Technology (OS member)
Kaminski, Amy	Office of Management and Budget
Kaplan, Mike	Boeing Corporation
Larkin, James	UCLA (OS member)
Lester, Dan	University of Texas
Lillie, Charles	NGST
Malay, John	Lockheed Martin
Margin, Bruce	Space Telescope Science Institute
McCandliss, S.R.	Johns Hopkins University
Meadows, Victoria	California Institute of Technology (OS member)
Morse, Jon	Arizona State University
Norman, Colin	The Johns Hopkins University (OS member)
Purcell, Bill	Ball Aerospace
Rainey, Patricia	Boeing Corporation
Richstone, Douglas	University of Michigan (OS member)
Rudiger, Chuck	Lockheed Martin ATC
Saha, Abhijit	National Optical Astronomy Obs (OS member)
Sherman, Al	Ball Aerospace
Spergel, David	Princeton University (OS Chair)
Tananbaum, Harry	Smithsonian Astrophysical Observatory
Turner, Kathy	Department of Energy
Zabludoff, Ann	University of Arizona (OS member)

APPENDIX B

Structure and Evolution of the Universe Subcommittee (SEUS)
February 24-25, 2004
Inn and Conference Center, University of Maryland University College
http://www.umuc.edu/icc/

Agenda

Last Revised: February 13

Tuesday, February 24

SEUS Session

8:00 – 8:30	Coffee and Conversation	
8:30 – 8:45	R. Kolb	Welcome, Report from SScAC
8:45 –9:45	P. Hertz	SEU Theme Update including Beyond Einstein, Einstein Probes, Vision Missions, and Explorers
9:45 – 10:00	Break	

SEUS & OS Joint Session

10:00 – 10:15	R. Kolb, D. Spergel	Welcome, Logistics, Introductions
10:15 – 11:15	A. Kinney	A&P Director's Report
11:15 – 11:45	M. Montemerlo	A&P Technology Requirements Survey
11:45 – 12:00		Discussion
12:00 – 1:00	Working Lunch	
12:00 – 1:00	H. Tananbaum	Lunch Talk: Chandra Science Results
1:00 – 2:00	A. Falcon	Annual Ethics Briefing
2:00 – 3:00	E. Weiler	AA's Report
3:00 – 3:15	Break	

SEUS Session

3:15 – 4:00	B. Cramer	LISA Update
4:00 – 4:45	L. Citrin	Con-X Update
4:45 – 5:30		Discussion

TBD Joint Committee Dinner

Wednesday, February 25

SEUS & OS Joint Session

8:00 – 8:30	Coffee and Conversation	
8:30 – 9:00	J. Hayes	R&A Update
9:00 – 9:30	P. Eberspeaker	High Altitude Sounding Rockets
9:30 – 9:45	AAAC Chair (tel)	Discussion of AAAC Report
9:45 – 10:00		Discussion of SAWG Report
10:00 – 10:15	Break	

SEUS Session

10:00 – 10:30	V. Jones	Balloon Program Update
10:30 – 11:00	R. Gould, P. DeMinco	SEU E/PO Update
11:00 – 12:15		Discussion
12:15 – 1:15	Working Lunch	Discussion

1:15 – 2:15	P. Hertz, M. Allen	Roadmap Planning
2:15 – 2:30	Break	
2:30 – 3:30		Discussion
3:30 – 4:00	R. Kolb, A. Kinney	Report to A&P Director
4:00	Adjourn	

APPENDIX C

STRUCTURE & EVOLUTION OF THE UNIVERSE SUBCOMMITTEE (SEUS) MEMBERS LIST

Dr. Edward W. Kolb (Chair) **2/12/05**
Theoretical Astrophysics, MS 209
Fermi National Accelerator Laboratory
Box 500
Batavia, IL 60510-0500
(630) 840-4695
FAX: (630) 840-8231
Email: rocky@fnal.gov

Dr. Joel Bregman **4/3/05**
Professor of Astronomy
Department of Astronomy
833 Dennison
University of Michigan
Ann Arbor, MI 48109-1090
TEL: (734) 764-3454
FAX: (734) 763-6317
Email: jbregman@astro.lsa.umich.edu

Dr. Michael Cherry **2/21/06**
Department of Physics and Astronomy
Louisiana State University
Baton Rouge, LA 70803
TEL: (225) 578-8591
FAX: (225) 578-1222)
Email: cherry@lsu.edu

Dr. Lynn R. Cominsky **11/27/04**
Department of Physics and Astronomy
Sonoma State University
1801 East Cotati Avenue
Rohnert Park, CA 94928-3609
TEL: (707) 664-2655
FAX: (800) 848-6369
Email: lynnc@charmian.sonoma.edu

Dr. Charles D. Dermer **11/27/04**
Code 7653
Naval Research Laboratory
4555 Overlook Avenue, SW
Washington, DC 20375-5352
Tel: (202) 767-2965
Fax: (202) 767-6473
Email: dermer@gamma.nrl.navy.mil

Dr. Lee Samuel Finn **2/21/06**
Director, Center for Gravitational Wave Physics Professor, Department of Physics, Astronomy and Astrophysics
The Pennsylvania State University
104 Davey Laboratory
University Park, PA 16802
Phone: 814 863-9598
Fax: 814 863-9608
Email: LSFinn@psu.edu

Dr. Kathryn Flanagan **11/27/04**
Room NE80-6103
Center for Space Research
Massachusetts Institute of Technology
77 Massachusetts Avenue
Cambridge, MA 02139
TEL: (617) 258-7324
FAX: (617) 253-8084
Email: kaf@space.mit.edu

Dr. Timothy M. Heckman **4/3/05**
Bloomberg 523
Department of Physics and Astronomy
The Johns Hopkins University
3400 North Charles Street
Baltimore, MD 21218-2686
TEL: (410) 516-7369
FAX: (410) 516-5096
Email: heckman@pha.jhu.edu

Dr. Craig J. Hogan **2/21/06**
Office of Research
Box 351202
University of Washington
Seattle, WA 98195-1202
TEL: (206) 616-4475
FAX: (206) 685-9210
Email: hogan@u.washington.edu

Dr. Lee G. Mundy **5/02/06**
Astronomy Program
University of Maryland
College Park, MD 20742
TEL: (301) 405-1529
FAX: (301) 314-9067
Email: lgm@astro.umd.edu

Dr. James S. Ulvestad **2/25/06**
National Radio Astronomy Observatory
P.O. Box 0
1003 Lopezville Road
Socorro, NM 87801-0387
TEL: (505) 835-7300
FAX: (505) 835-7320
Email: julvesta@nrao.edu

Dr. Nicholas E. White **10/4/04**
Code 660.0
Goddard Space Flight Center
National Aeronautics and Space Administration
Greenbelt Road
Greenbelt, MD 20771
TEL: (301) 286-8443
FAX: (301) 286-0250
Email: nwhite@lheapop.gsfc.nasa.gov

Dr. Edward L. Wright **4/5/05**
Professor of Astronomy
Department of Astronomy
University of California at Los Angeles
P.O. Box 951562
Los Angeles, Ca 90095-1562
TEL: (310) 825-5755
FAX: (310) 206-2096
Email: wright@astro.ucla.edu

Dr. Harold W. Yorke **11/27/04**
MS 169-506
Jet Propulsion Laboratory
National Aeronautics and Space Administration
4800 Oak Grove Drive
Pasadena, CA 91109-8099
TEL: (818) 354-0336
FAX: (818) 354-8895
Email: harold.w.yorke@jpl.nasa.gov

Dr. Paul Hertz (Executive Secretary)
Office of Space Science
NASA Headquarters
300 E Street, SW
Washington, DC 20546-0001
TEL: (202) 358-0986
FAX: (202) 358-3096
Email: paul.hertz@nasa.gov

Ms. Marian R. Norris (Administrative Officer)
Management Support Specialist
Code SB
NASA Headquarters
Washington, DC 20546
TEl: 202-358-4452
FAX: 202-358-3092
E-mail: mnorris@nasa.gov

Note: Expiration Dates in Bold
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APPENDIX D

Presentations

1. SEU Theme Update: Including Beyond Einstein, Einstein Probes, and Vision Missions: *Paul Hertz, SEU Theme Scientist*
2. Astronomy and Physics Division Overview; *Dr. Anne Kinney, Astronomy and Physics Division Director*
3. Space Science and the President's Spirit of Discovery; *Dr. Ed Weiler, Associate Administrator*
4. Options for Future Explorer Program*; Dr. Paul Hertz*
5. LISA Project Status; *Mr. Bryant Cramer, Program Manager*
6. Sounding Rocket Briefing; *Mr. Philip Eberspeaker*
7. Education/Outreach*; Mr. Roy Gould, SEU Forum*
8. Beyond Einstein E&PO Strategy Status Report: *Mr. Paul A. DeMinco*

Materials Distributed

1. Synopsis of the First Annual Report of the Astronomy and Astrophysics Advisory Committee; *Robert D. Gehrz, Chair*
2. Enabling Technologies for Future Missions; the OS and SEU Themes; *Melvin Montemerlo*
3. Astronomy and Physics Technology Development Strategies
4. Report of the October 2003 Meeting of the Science Archives Working Group

Online Availability

Presentations and distributed material are available on the Internet at

http://spacescience.nasa.gov/admin/divisions/sz/SEUS0402/.